CLAIMS

What is claimed is:

1. A method of phase processing in-phase and quadrature signals comprising:

receiving successive digital in-phase and quadrature complex samples;

providing a corresponding phase offset estimate for each of the successive digital in phase and quadrature complex samples;

for each sample, compensating for phase drift by iteratively scaling, manipulating, updating the in-phase and quadrature complex samples and the corresponding phase estimate to converge to a compensated sample value.

2. The method of claim 1, wherein iteratively scaling, manipulating, and updating uses a plurality of pre-computed angles.

3. The method of claim 2, wherein the plurality of pre-computed angles ϕ_n, are defined by ϕ_n = arctangent $(1/2^n)$, n being an integer variable having unique value corresponding to each of the plurality of pre-computed angles.

4. The method of claim 1, wherein iteratively scaling, manipulating, and updating comprises:

shifting the in-phase and quadrature complex samples and the corresponding phase estimate; and

adding the in-phase and quadrature complex samples and the corresponding phase estimate.

5. The method of claim 4, wherein shift operations use barrel shifters.

6. The method of claim 1, wherein providing a corresponding phase offset estimate comprises updating, for each sample, the phase offset estimate.

7. The method of claim 6, wherein updating the phase offset estimate comprises:

determining for the compensated sample value, an associated compensated sample angle;

determining for the compensated sample value, an expected symbol value having an associated expected symbol angle;

determining a difference angle between the compensated sample angle and the expected symbol angle; and

updating the phase offset estimate using the determined difference angle.

8. The method of claim 7, wherein determining the compensated sample angle comprises:

providing a compensated sample angle estimate; and

iteratively scaling, manipulating, updating the compensated sample value and the compensated sample angle estimate to converge to a compensated sample angle.

9. The method of claim 8, wherein iteratively scaling, manipulating, and updating uses a plurality of pre-computed angles.

10. The method of claim 9, wherein the plurality of pre-computed angles ϕ_n, are defined by ϕ_n = arctangent $(1/2^n)$, n being a integer variable having unique value corresponding to each of the plurality of pre-computed angles.

11. The method of claim 8, wherein iteratively scaling, manipulating, and updating comprises:

shifting the compensated sample value and the compensated sample angle estimate; and

adding the compensated sample value and the compensated sample angle estimate.

12. The method of claim 11, wherein shift operations use barrel shifters.

13. The method of claim 7, wherein determining the expected symbol value having an associated expected symbol angle uses a look-up table.

14. The method of claim 7, wherein updating the phase offset estimate comprises combining the determined difference angle with the phase offset estimate.

15. The method of claim 7, further comprising filtering the determined difference angle.

16. The method of claim 15, wherein filtering comprises adjusting a gain of the determined difference angle.

17. The method of claim 7, further comprising initially converting the compensated sample value to a corresponding compensated sample value residing in a first quadrant.

18. The method of claim 17, wherein converting comprises manipulating the sign of each of the respective in-phase and quadrature compensated sample value.

19. An apparatus for phase processing in-phase and quadrature signals comprising:

a receiver configured to receive successive digital in-phase and quadrature complex samples;

a phase offset register storing a corresponding estimate of the phase offset for each of the successive digital in-phase and quadrature complex samples;

phase compensating circuitry in electrical communication with the receiver and the phase offset register, the phase compensating circuitry compensating each sample for phase drift by iteratively scaling, manipulating,

updating the in-phase and quadrature complex samples and the corresponding phase estimate to converge to a compensated sample value.

20. The apparatus of claim 19, wherein the phase compensating circuitry comprises:

a first register temporarily storing an in-phase component of each of the digital complex samples;

a second register temporarily storing a corresponding quadrature component of each of the digital complex samples;

a first adder receiving an input from each of the first and second registers and providing an output to the first register;

a second adder receiving an input from each of the first and second registers and providing an output to the second register;

a third register temporarily storing the corresponding phase estimate;

a memory unit storing a plurality of pre-computed angles; and

a third adder receiving an input from each of the third register and the memory unit and providing an output to the third register, each of the adders capable of selectively adding and subtracting its respective input values, the phase compensating circuitry iteratively scaling, manipulating, and updating each sample using the stored plurality of pre-computed angles.

21. The apparatus of claim 20, wherein the plurality of pre-computed angles ϕ_n, are defined by ϕ_n = arctangent $(1/2^n)$, n being a integer variable having unique value corresponding to each of the plurality of pre-computed angles.

22. The apparatus of claim 20, further comprising:

a first arithmetic shifter providing a shifted version of the stored in-phase component, the first arithmetic shifter coupled between the first register and the second adder; and

a second arithmetic shifter providing a shifted version of the stored quadrature component, the second arithmetic shifter coupled between the second register and the first adder.

23. The apparatus of claim 19, further comprising phase offset circuitry in electrical communication with the phase compensating circuitry and the phase offset register, the phase offset circuitry updating, for each sample, the phase offset estimate.

24. The apparatus of claim 23, wherein updating the phase offset circuitry comprises:

a first register temporarily storing in-phase component of each of the compensated samples;

a second register temporarily storing quadrature component of each of the compensated samples;

a first adder receiving an input from each of the first and second registers and providing an output to the first register;

a second adder receiving an input from each of the first and second registers and providing an output to the second register;

a third register temporarily storing the corresponding phase estimate;

a memory unit storing a plurality of pre-computed angles; and

a third adder receiving an input from each of the third register and the memory unit and providing an output to the third register, each of the adders capable of selectively adding and subtracting its respective input values, the phase offset circuitry iteratively scaling, manipulating, and updating each sample using the stored plurality of pre-computed angles to determine an angle associated with the compensated sample.

25. The apparatus of claim 24, wherein the plurality of pre-computed angles ϕ_n, are defined by ϕ_n = arctangent $(1/2^n)$, n being an integer variable having unique value corresponding to each of the plurality of pre-computed angles.

26. The apparatus of claim 24, further comprising:

a first arithmetic shifter coupled between the first register and the second adder, the first arithmetic shifter providing a shifted version of the stored in-phase component; and

a second arithmetic shifter coupled between the second register and the first adder, the second arithmetic shifter providing a shifted version of the stored quadrature component.

27. The method of claim 23, further comprising:

a slicer determining an expected symbol value for the compensated sample, the expected symbol value having an associated angle; and

a first adder coupled to the slicer and to the phase offset circuitry, the adder configured to determine the difference between the angle associated with the expected symbol value and the angle associated with the compensated sample.

28. The apparatus of claim 27, further comprising a second adder coupled to the phase offset register and to the output of the first adder, the output of the second adder also coupled to the phase offset register for determining and storing an accumulating phase offset value.

29. The apparatus of claim 28, further comprising a loop filter coupled between the first adder and the second adder.

30. The apparatus of claim 29, wherein the loop filter comprises a gain device.

31. The apparatus of claim 24, further comprising quadrant offset circuitry configured to manipulate the sign of each of the respective in-phase and quadrature component of the received sample thereby transforming it into a corresponding sample residing in a first quadrant.

32. An apparatus for phase processing in-phase and quadrature signals comprising:

means for receiving successive digital in-phase and quadrature complex samples;

means for providing a corresponding phase offset estimate for each of the successive digital in-phase and quadrature complex samples;

means for compensating for phase drift for each sample by iteratively scaling, manipulating, updating the in-phase and quadrature complex samples and the corresponding phase estimate to converge to a compensated sample value.

33. A method of phase processing in-phase and quadrature signals comprising:

receiving successive digital in-phase and quadrature complex samples;

for each sample, iteratively scaling, manipulating, and updating the in-phase and quadrature complex samples and a corresponding phase estimate to converge to a final result.

34. An apparatus for phase processing in-phase and quadrature signals comprising:

receiving successive digital in-phase and quadrature complex samples;

for each sample, iteratively scaling, manipulating, and updating the in-phase and quadrature complex samples and a corresponding phase estimate to converge to a final result.